United States Department of the Interior
Oscar L. Chapman, Secretary
Fish and Wildlife Service
Albert M. Day, Director

Special Scientific Report - Fisheries
No. 10

DRIFT BOTTLE RELEASES OFF NEW JERSEY

A PRELIMINARY REPORT ON EXPERIMENTS BEGUN IN 1948

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INTRODUCTION

Waste by-products, consisting of a solution of sulphuric acid and ferrous sulphate, from an industrial plant in New Jersey, were dumped in a position approximately 11 nautical miles south of Ambrose Light between April 1948 and April 1949. Other nearby locations have been used since. Individuals and associations have objected to this practice contending that it jeopardized health, marine life, and important fisheries.

To determine if these objections are tenable, the National Research Council has sponsored an investigation to find out the detrimental effects, if any, of these waste-products. There are parts of this investigation that cover several phases, but the present paper concerns only the possible drift of the waste-products. Drift bottles, which approximate the action of flotsam responsive to prevailing ocean currents, were used as indicators.

Two sizes of bottles were used. A common 12-ounce beer bottle, and an 8-ounce round bottle. The 12-ounce bottle was provided with a drag made from 4 feet of monel wire and a bent piece of sheet aluminum, 4 inches by 5 inches, to minimize wind effect and increase surface current effect. Both size bottles floated with 1 inch or less showing above the surface.

These bottles were water-tight and made of clear glass. Inserts consisted of a standard one-cent postal card addressed to the Woods Hole Oceanographic Institution and a piece of orange paper describing the purpose of the experiment (Figure 1). The orange paper when inserted in the bottle unrolled to reveal its request to the finder.

Note: The responsibility for studying the drift of floating objects was delegated to the United States Fish and Wildlife Service Laboratory at Woods Hole, Massachusetts. Numerous members of the laboratory staff assisted in the preparation of bottles for release. Assistance was also offered, and gratefully received from Dr. Bostwick Ketchum of the Woods Hole Oceanographic Institution and Mr. Norman Canfield of the United States Weather Bureau office at Boston. The offshore work in connection with these studies was supervised by Dr. Ketchum, and most of the bottle releases were made during two trips under his charge. The financial details of purchasing supplies and making payments of rewards were managed by the Woods Hole Oceanographic Institution also. Interpretations of daily weather observations and information on wind force and direction in the region of bottle releases were supplied by Mr. Canfield. The most important participants in this drift bottle study however, are those persons who found the bottles and reported them. Their cooperation was surely motivated by more than the small reward that was offered.

BREAK THIS BOTTLE

This bottle is one of several hundred released at sea in the New Jersey-New York region to study ocean currents. The exact place and date of release has been recorded and is on file.

You can make the record for this bottle complete by furnishing the information requested on the enclosed postal card. We will send a reward of fifty cents ($.50) for each card returned with the best information you can provide.

Your information will be combined with that sent in by other finders of bottles. This is part of a study of the drift of floating objects being conducted by the National Research Council and the Woods Hole Oceanographic Institution in cooperation with Federal and State Agencies.

Your cooperation in giving accurate information will be of great aid.

Nº 2099

FINDER OF THIS BOTTLE
PLEASE FILL IN THE INFORMATION
AS INDICATED AND SEND BY MAIL

Nº 2099

When found, date .....

Where found (name of beach or place on shore, near what Coast Guard station, Lighthouse, or other prominent reference point) .....

.....

Were wire and metal drag attached? .....

Your Name (sign and print) .....

Your Home Address (print) .....

.....

Fifty Cents ($.50) will be sent to finder on return of this card.

DRIFT BOTTLE INSERTS

Figure 1.-- Drift bottle inserts

In this report on the drift bottle study which was begun in 1948 several terms recur. These terms will have greater meaning if defined at the outset.

The disposal area is a position at sea, 2 miles square, centered by the coordinates latitude 40° 15' 24" N. and longitude 73° 46' 25" W. This position is approximately 10 miles east of Elberon, New Jersey and 11 miles south of Ambrose Lightship.

The area of immediate concern for the purpose of this report is arbitrarily bounded on the east by longitude 73° 00' W., on the south by latitude 39° 00' N., and on the west and north by the coasts of New Jersey and Long Island, New York, respectively. Hydrographic sampling stations visited by the vessels of the Woods Hole Oceanographic Institution lie within this area. The acid component of the waste-product released in the disposal area is chemically undetectable by the time it is transported by existing currents to the southern limits of the area (Ketchum and Ford, 1948).

Drift intervals are the number of days elapsed between the dates of bottle releases and the reported recovery or suspected beaching.

Minimum course tracks are the shortest probable tracks between the points of release and reported recoveries. They are not always rhumb lines, for when land intervenes the tracks must arbitrarily be led around to avoid it.

BALANUS RELEASES

COMMENTS ON RECOVERIES

On July 27 and 28 observers on the vessel Balanus released 15 bottles at each of 16 stations -- a total of 240 bottles. All releases were made within the area bounded by 40° 27' N., latitude 40° 19' N., longitude 73° 22' W., and the coast of New Jersey. As of January 15, 1949 there were 23 recoveries from 10 stations. All recoveries show evidence of drift to the south and west. These recoveries came in from North Long Branch, New Jersey and points southward to North Carolina, and between intervals of 1 day and 166 days after release. See Table 1 and Figure 2.

a. Recoveries from New Jersey

For ease in following the comments on recoveries, the grid of the 16 release stations has been designated as follows: the north-south lines as 1, 2, 3, 4 to the eastward; and the east-west lines as A, B, C, and D to the southward.

Table 1.--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES			RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N.	Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
27 July	40°-20½'	73°-55½'	102	30 Sept. 48	....	½ m No. of Fenwick L.H. Delaware	126	65	1.9
	Station B-1								
	15 Bottles		110	29 Sept. 48	....	1 m So. of Bethany Beach, Delaware	123	64	1.9
27 July	40°-15½'	73°-55½'	No Recoveries Reported						
	Station C-1								
	15 Bottles								
27 July	40°-15½'	73°-46½'	131	5 Jan. 49	W	Currituck Beach, North Carolina	259	162	1.6
	Station C-2								
	15 Bottles								
27 July	40°-15½'	73°-35½'	No Recoveries Reported						
	Station C-3								
	15 Bottles								
27 July	40°-15½'	73°-25'	169	28 Sept. 48	W	Nags Head, N. C.	275	63	4.4
	Station C-4		173	28 Sept. 48	W	7 m No. of Nags Head, N. C.	270	63	4.3
	15 Bottles								
27 July	40°-09½'	73°-25'	184	7 Nov. 48	....	Currituck Beach, North Carolina	250	103	2.4
	Station D-4								
	15 Bottles		186	7 Jan. 49	....	Currituck Beach North Carolina	252	164	1.5

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES		RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N. Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
27 July	40°-09½' 73°-35½' Station D-3 15 Bottles	No recoveries reported						
27 July	40°-09½' 73°-46½' Station D-2 15 Bottles	No recoveries reported						
28 July	40°-09½' 73°-55½' Station D-1 15 Bottles	223	7 Sept. 48	W	Margate City, N.J.	57	41	1.4
		228	7 Oct. 48	....	Near Wash Woods C. G. Station, N.C.	237	71	3.3
28 July	40°-20½' 73°-46½' Station B-2 15 Bottles	239	17 Sept. 48	W	12½ m ESE Fenwick Lighthouse, Md.	128	51	2.5
28 July	40°-20½' 73°-35½' Station B-3 15 Bottles	No recoveries reported						
28 July	40°-20½' 73°-23½' Station B-4 15 Bottles	No recoveries reported						
28 July	40°-26½' 73°-22½' Station A-4 15 Bottles	281	6 Oct. 48	W	Little Island C.G. Sta., Va.	252	70	3.6
		284	28 Sept. 48	....	Kitty Hawk, N.C.	285	62	4.6

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES		RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N. Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
28 July	40°-26½' 73°-22½' Station A-4 15 Bottles	285	12 Aug. 48	D	Atlantic City, N.J. 50 ft. Offshore	80	15	5.3
		289	20 Aug. 48	D	Longport, N.J.	85	23	3.7
28 July	40°-26½' 73°-35½' Station A-3 15 Bottles	297	29 Sept. 48	W	Nags Head, N. C.	280	63	4.4
		300	21 Aug. 48	....	Tucker Island, New Jersey	64	24	2.7
28 July	40°-26½' 73°-46½' Station A-2 15 Bottles	312	12 Sept. 48	....	Ocean City, N. J.	80	42	1.9
		314	28 Sept. 48	....	Asseteague, Md.	160	62	2.6
		317	16 Sept. 48	W	Island Beach, N.J.	65	50	1.2
		320	10 Jan. 49	....	4 m So. of Little Island C. G. Sta. Virginia	249	166	1.5
		322	7 Sept. 48	....	Ocean City, N. J.	79	41	1.9
28 July	40°-26½' 73°-55½' Station A-1 15 Bottles	331	29 July 48	No	Sea Bright, N. J. 1 m offshore	8½	1	8.5
		339	29 July 48	D	No. Long Branch, N.J. 50 yds. offshore	5½	1	5.5
22 Oct.	40°-27½' 73°-11' Station A-5 15 Bottles	No recoveries reported						

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES		RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N. Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
22 Oct.	40°-26½' 73°-55½' Station A-1 15 Bottles	485	23 Oct. 48	D	Sea Bright, N.J.	5½	1	5.5
		605	23 Oct. 48	D	Sea Bright, N.J.	6½	1	6.5
		609	24 Oct. 48	D	Sea Bright, N.J.	7	2	3.5
23 Oct.	40°-26½' 73°-46½' Station A-2 15 Bottles	No recoveries reported						
23 Oct.	40°-26½' 73°-37½' Station A-3 15 Bottles	No recoveries reported						
23 Oct.	40°-20½' 73°-25' Station B-4 15 Bottles	No recoveries reported						
23 Oct.	40°-20½' 73°-35½' Station B-3 15 Bottles	No recoveries reported						
23 Oct.	40°-20½' 73°-46½' Station B-2 15 Bottles	No recoveries reported						
26 Oct.	40°-20½' 73°-55' Station B-1 15 Bottles	351	4 Nov. 48	D	Sea Girt Light-house, N. J.	14	9	1.5

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES		RECOVERIES [1]				DRIFT [1]		
Date 1948	Position Lat. N. Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
26 Oct.	40°-20½' 73°-55' Station B-1 15 Bottles	352	8 Nov. 48	....	Sea Girt Lighthouse New Jersey	13	13	1.0
		590	4 Nov. 48	....	Spring Lake Beach New Jersey	9	9	1.0
		592	3 Nov. 48	....	Sea Girt Lighthouse New Jersey	11½	8	1.4
26 Oct.	40°-15½' 73°-55½' Station C-1 15 Bottles	354	6 Nov. 48	....	Seaside Park, N. J.	22	11	2.0
		359	3 Nov. 48	D	Island Beach, N. J.	25½	8	3.2
		360	31 Oct. 48	....	Normandy Beach, N.J.	8½	5	1.7
		361	5 Nov. 48	D	Lavallette Beach, New Jersey	20	10	2.0
		362	4 Nov. 48	D	Ocean Beach, N. J.	17	9	1.9
		364	4 Nov. 48	D	Lavallette Beach, New Jersey	18	9	2.0
		365	4 Nov. 48	D	Lavallette Beach, New Jersey	19	9	2.1
		366	5 Nov. 48	....	Island Beach, N. J.	21	10	2.1
		368	6 Nov. 48	....	Seaside Park, N. J.	23	11	2.1
		369	4 Nov. 48	D	Sea Girt, N. J.	10½	9	1.2
27 Oct.	40°-15½' 73°-46½' Station C-2 15 Bottles	621	4 Nov. 48	D	Bay Head, N. J.	17	9	1.9
		622	6 Nov. 48	....	Seaside Park, N. J.	25½	11	2.3
		623	4 Nov. 48	No	Allenhurst, N.J.	10	9	1.1
		625	3 Nov. 48	D	Avon, N. J.	11½	8	1.4
		626	6 Nov. 48	....	Mantoloking Beach New Jersey	18½	11	1.7

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES			RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N.	Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
27 Oct.	40°-15½'	73°-46½'	627	6 Nov. 48	D	Mantoloking Beach New Jersey	19½	11	1.8
	Station C-2		631	3 Nov. 48	D	Point Pleasant Beach, N. J.	15½	8	2.
	15 Bottles		633	19 Nov. 48	D	Head of Barnegat Bay, N.J.	?	23	?
27 Oct.	40°-15½'	73°-35½'	No recoveries reported						
	Station C-3								
	15 Bottles								
27 Oct.	40°-15½'	73°-25'	No recoveries reported						
	Station C-4								
	15 Bottles								
27 Oct.	40°-19'	73°-11'	No recoveries reported						
	Station B-5								
	16 Bottles								
1 Nov.	40°-15'	73°-45'	666	4 Nov. 48	....	Chadwick Beach, New Jersey	20½	3	6.8
	Station C-2		667	3 Nov. 48	D	Mantoloking, N. J.	19	2	9.5
	14 Bottles		668	3 Nov. 48	....	Point Pleasant Beach, N. J.	16½	2	8.2
			669	4 Nov. 48	D	Lavallette Beach New Jersey	22	3	7.3
			670	20 Nov. 48	....	Mantoloking Beach New Jersey	19½	1[illegible]	1.0

Table 1.(Cont'd)--Bottle release and recovery data based on releases made from the vessels Balanus, Caryn and Albatross III

RELEASES			RECOVERIES 1/				DRIFT 1/		
Date 1948	Position Lat. N.	Long. W.	Bottle No.	Date	Drag	Recovery Locality	Dist. Miles	Time Days	Speed M/Day
1 Nov.	40°-15'	73°-45'	671	5 Nov. 48	D	Manasquan River Inlet, N. J.	15½	4	3.9
	Station C-2		672	7 Nov. 48	....	Point Pleasant Beach, N. J.	16	6	2.7
	14 Bottles		675	4 Nov. 48	D	Ocean Beach, New Jersey	21½	3	7.1
			676	3 Nov. 48	....	Point Pleasant Beach, N. J.	17	2	8.5
			677	4 Nov. 48	No	Chadwick Beach, New Jersey	20	3	6.7
			678	7 Nov. 48	....	Bay Head Yacht Club, N. J.	18	6	3.0
			679	4 Nov. 48	D	Lavallette Beach, New Jersey	23	3	7.7
1 Nov.	40°-05'	73°-35'	No recoveries reported						
	20 Bottles								
1 Nov.	39°-55'	73°-15'	No recoveries reported						
	20 Bottles								

1/ Explanation of symbols and terms:

Drag: denotes reported condition of drag when found.
D: finder reported both wire and drag attached.
W: finder reported only wire attached.
No: finder reported wire and drag absent.
....: bottle released without drag.
Time Days: denotes elapsed time in days between dates of release and reported recovery.
Dist. Miles: denotes the shortest drift track via water, between points of release and recovery, in nautical miles.
Speed M/Day: denotes speed of drift in elapsed time over shortest track in nautical miles-per-day.

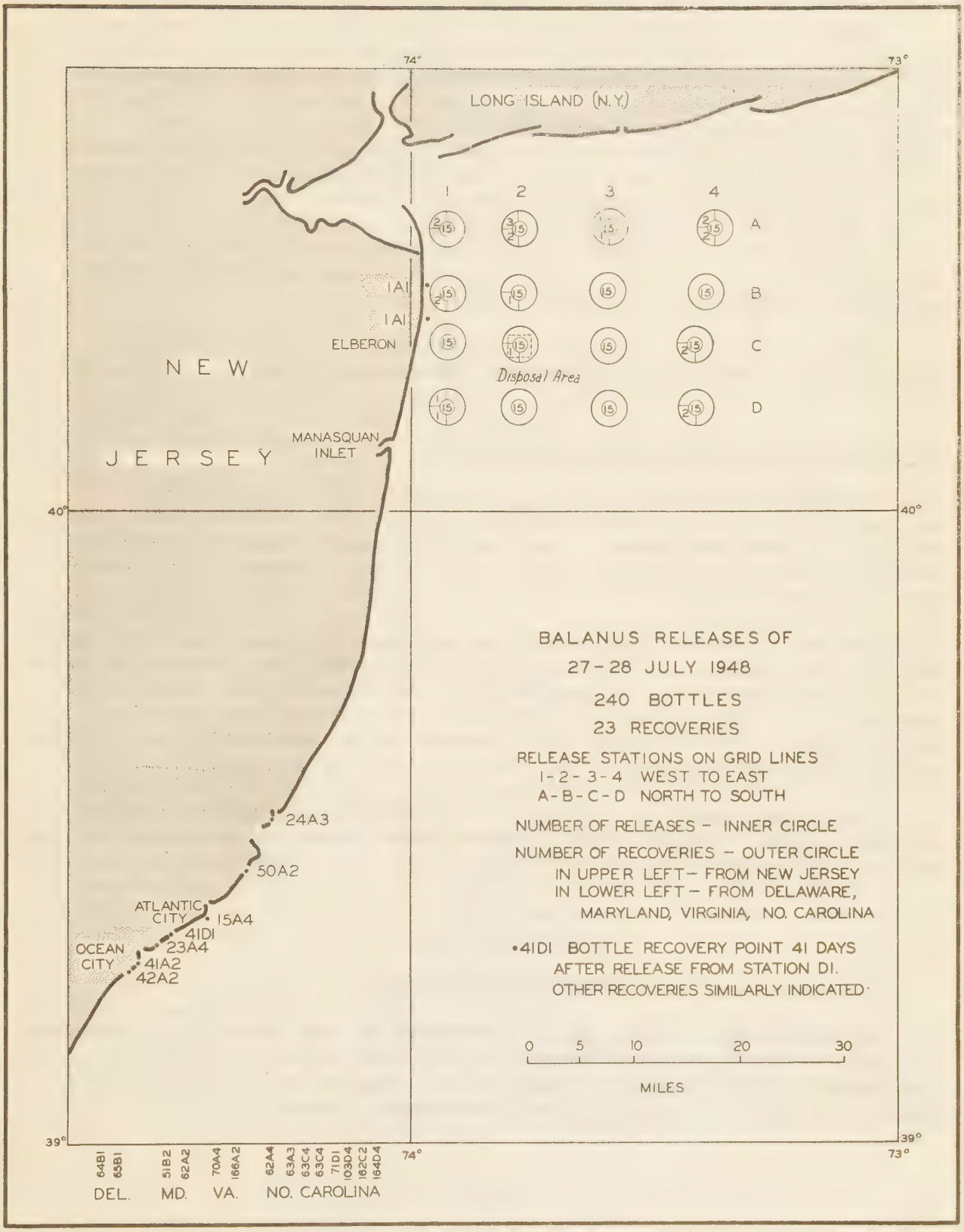

Figure 2.-- Balanus releases of July 27-28, 1948

Probably the best data on the rate of drift are derived from the returns of two bottles released at Station A-1 and one bottle released at Station A-4. All three were reported found adrift just offshore, so the question of how long they remained undiscovered on the beach does not apply. The first two came in at Northern New Jersey after one day, indicating a drift of 5 to 8 miles-per-day. The third, found off Atlantic City after a drift interval of 15 days and course track not less than 85 miles, is evidence of a drift of at least 6 miles-per-day.

A companion to the third bottle (above) was reported found 8 days later about 5 miles farther to the southwest on the beach. Its minimum drift speed was 4.5 miles-per-day, a fair agreement.

The remainder of the New Jersey recoveries, five in all, do not duplicate the above discussed bottles with respect to minimum drift speed.

b. Recoveries from Delaware Southward to North Carolina

Fourteen bottles from the Balanus releases drifted to Delaware, Maryland, Virginia, and North Carolina. Since these recoveries are outside the area of immediate concern, they are of interest primarily for their revelation of the directions of drift, though the information on speed of drift is interesting.

One bottle released at Station A-4 was found 62 days later at Kitty Hawk, North Carolina. This bottle covered a distance of at least 285 miles at a minimum speed of 4.6 miles-per-day. Two other bottles released at Station C-4 and one released at Station A-3 were reported at Nags Head, North Carolina after 63 days. With minimum course tracks of about 275 miles the minimum speed of these bottles was about 4.4 miles-per-day.

Some disagreement is apparent in the recovery of a bottle at sea 12 miles ESE of Fenwick Lighthouse which was released at Station B-2 51 days earlier. It traveled at least 2.5 miles-per-day for 128 miles.

CARYN RELEASES

COMMENTS ON RECOVERIES

On October 22, 23, 26, and 27, observers on the vessel Caryn released 195 bottles within the area bounded by latitudes 40° 27' and 40° 15' N., longitude 73° 06' W., and the coast of New Jersey. These releases were made at 13 stations, usually 15 bottles at each station.

As of January 15, 1949, there had been 25 recoveries from four of the stations (Table 1). They were picked up on the New Jersey coast from near Navesink southward to Island Beach near Barnegat. Their drift intervals were from 1 day to 23 days. All recovery points are plotted in Figure 3.

Again, all recoveries but one showed a drift to the south and west. Inasmuch as all the recoveries came from New Jersey, and for ease in making comment, the recoveries will be discussed by their release stations. The station designation used in discussing the Balanus releases will again be used.

a. Station A-1

Two bottles were reported found the day after release. Their minimum course tracks were 6 miles and thus we estimate a drift speed of at least 6 miles-per-day. A third bottle, found relatively close to these on the second day after release, perhaps had lain on the beach unnoticed for one day.

b. Station B-1

Earliest recoveries came ashore between Belmar and Manasquan, New Jersey, 8 days after release and 13 miles away. With no assumptions as to delays, their minimum drift speeds were 1.6 miles-per-day. A fourth bottle was found in the same vicinity 13 days after release.

c. Station C-1

Eight bottles from this station were found along a 10-mile stretch of the coast between Island Beach and Ocean Beach near Seaside Park. The minimum course tracks of these bottles varied between 17 miles and 25 miles, and their drift intervals varied from 8 to 11 days. The best performance was shown by a bottle which drifted at least 25 miles in 8 days for a calculated speed of 3 miles-per-day. Calculated speeds of the others averaged approximately 2 miles-per-day.

One bottle released at this station deserves special comment. This was found near Navesink 5 days after release. Its minimum course track was about 8 1/2 miles in a northwesterly direction from the release station. It is possible that this bottle was beached following an initial drift with the current, and that its companion bottles behaved similarly but escaped beaching or beached and were refloated before they were discovered.

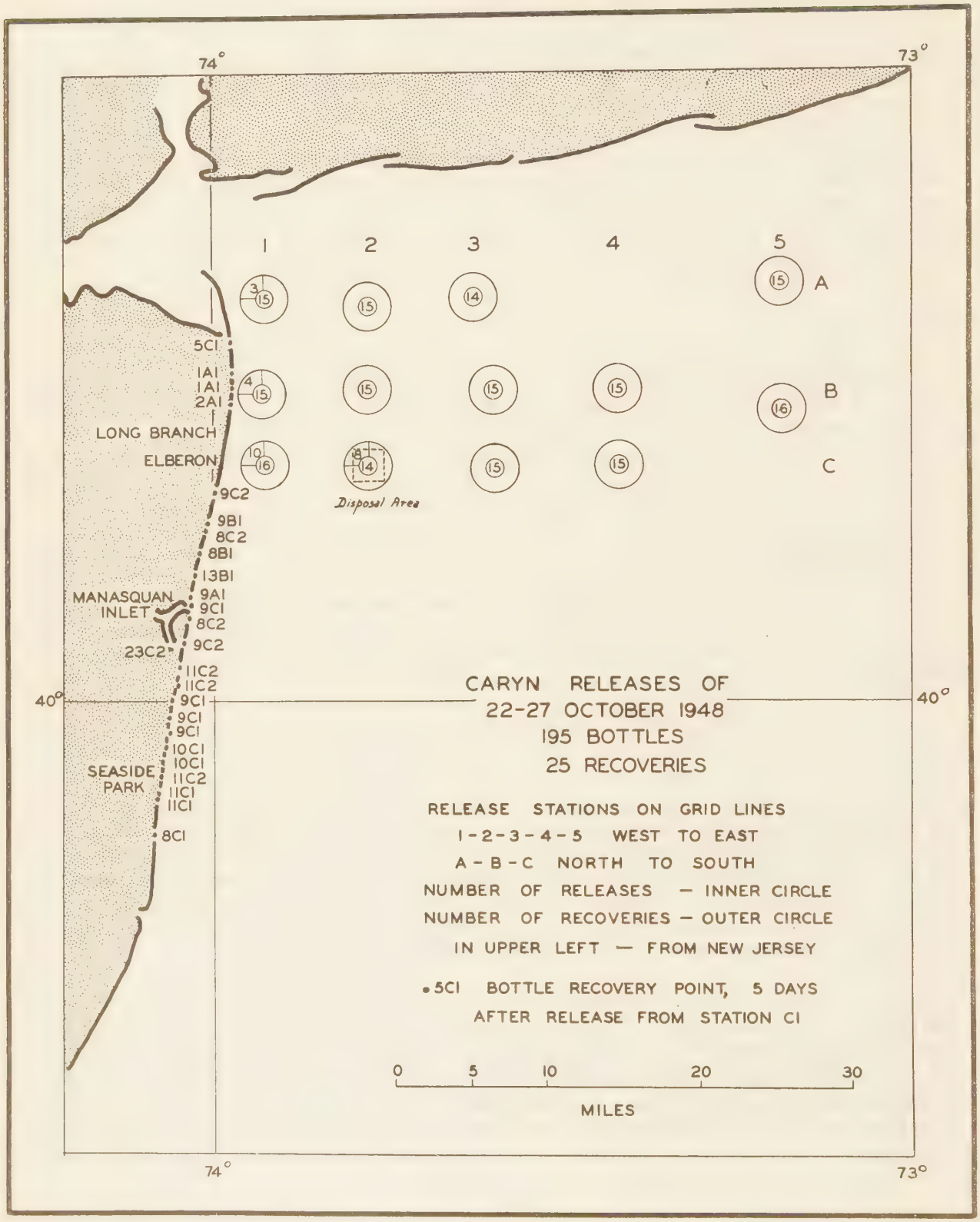

Figure 3.-- Recovery points plotted for Caryn releases of October 22-27, 1948

d. Station C-2

This release station was located within the boundaries of the disposal area. Of 14 bottles released in this locality, 8 were reported from New Jersey within the 20 miles between Asbury Park and Seaside Park.

Minimum course tracks of these bottles varied between 10 miles and 21 miles. With one exception, the drift intervals varied from 7 to 10 days. On the basis of these tracks and intervals, the returns from this release evidence a drift to the south and west at a minimum average speed of 1.7 miles-per-day.

Notwithstanding the calculated reconstruction of drift bottle activity, drift bottle returns from this station suggest that floating objects released in the disposal area on October 27 were carried toward the New Jersey shore. The indicated speed-made-good was from 1.1 to 2.3 miles-per-day.

ALBATROSS III RELEASES

Observers on the vessel Albatross III released 54 bottles on November 1 at three stations southeast from Sandy Hook, 14 bottles at 18 miles (station C-2 in the grid arrangement and disposal area), 20 bottles at 30 miles, and 20 bottles at 49 miles. These release stations and the recovery points of bottles returned from these releases are shown in Figure 4 and Table 1.

COMMENTS ON RECOVERIES

a. Recoveries from New Jersey

As of January 15, 1949, twelve bottles from the Albatross III releases had been reported, all from the innermost station (the disposal area). These bottles came in to the New Jersey shore along a 10-mile stretch of beach south of Manasquan. The minimum course tracks of this group varied from 15 to 23 miles. Their drift intervals varied between two and six days, except one which was reported 19 days after release.

Eight returns from this release are especially interesting because of their consistency. Illustrating an example of bottle recoveries that furnish reliable drift information a tabulation of these returns follows:

Bottle No.	
668	drifted approximately 16 miles in 2 days at about 8 miles/day
676	drifted approximately 17 miles in 2 days at about 8 miles/day

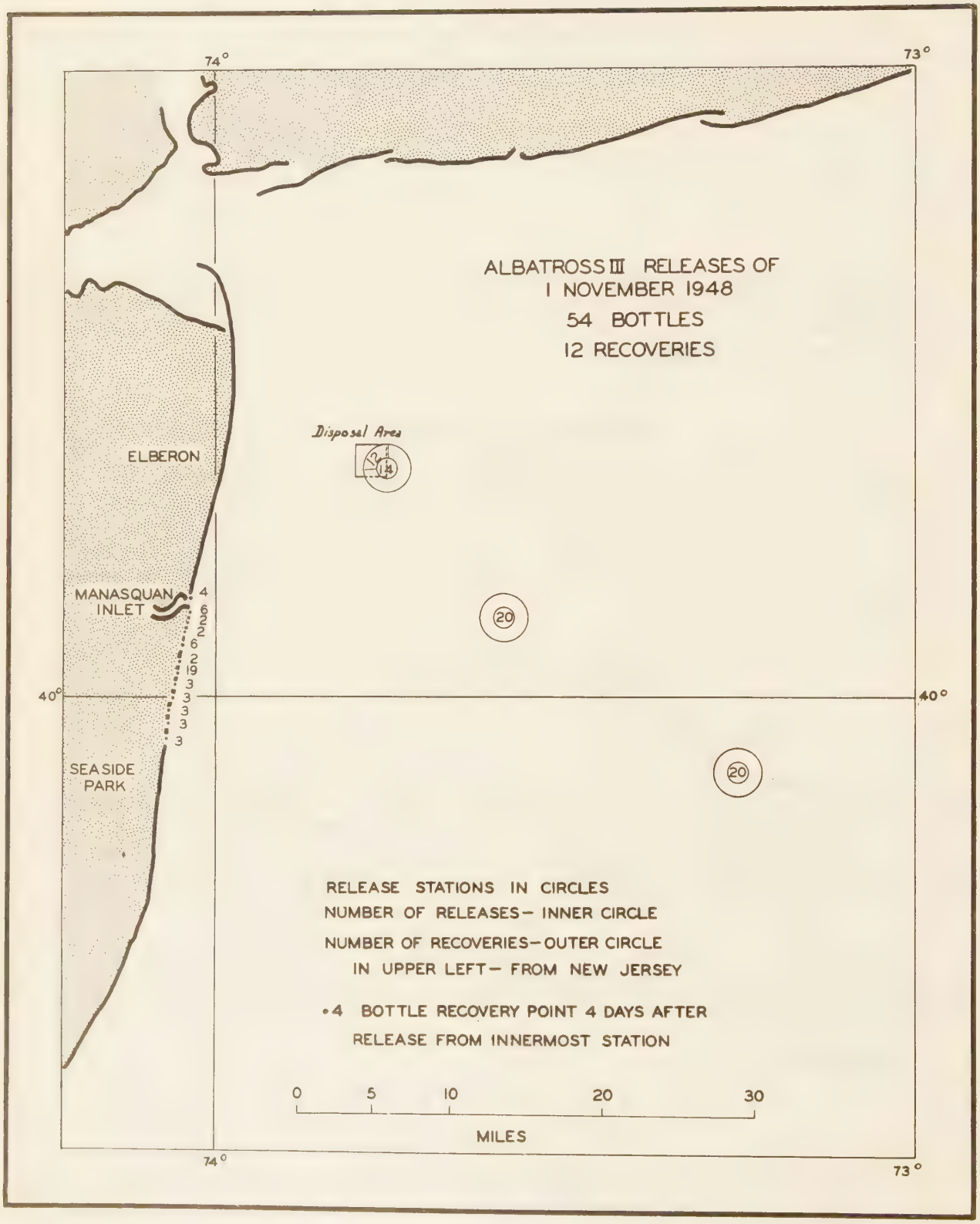

Figure 4.-- Release Stations and Recovery Points of November 1, 1948

Bottle No.

667 drifted approximately 19 miles in 2 days at about 9 miles/day

677 drifted approximately 20 miles in 3 days at about 7 miles/day

668 drifted approximately 20 miles in 3 days at about 7 miles/day

675 drifted approximately 21 miles in 3 days at about 7 miles/day

669 drifted approximately 22 miles in 3 days at about 7 miles/day

679 drifted approximately 23 miles in 3 days at about 8 miles/day

These returns, like the Caryn returns, also suggest that floating objects released in the disposal area on November 1 were carried southwesterly toward the New Jersey shore.

NOTES ON THE INFLUENCE OF WIND AND DRAGS

Flotsam or floating objects, such as the drift bottles used in this experiment, are subject to winds directly through the exposed surface and indirectly through winds which impel the surface layers and produce a drift current. In order to detect any direct effect of wind the odd-numbered bottles were supplied with drags to minimize the effect of wind-produced currents on the speed of transport.

With but one exception, -- a bottle from the Caryn releases which apparently drifted in a northwesterly direction -- the returns from the 1948 Balanus, Caryn, and Albatross III releases indicate a drift to the south and west. This posed a question. Could the winds during the periods between bottle releases and recoveries, and the presence or absence of drags, have had any influence on their drift patterns or speed of transport?

Accordingly, readings of the wind force and direction in true compass quadrants were determined at 6 hour intervals from Weather Bureau charts for the general area of release stations. The interval chosen for recoveries from the Balanus releases was from July 27 through August 31 because it includes the date of first releases and the date by which all the bottles still afloat had presumably drifted out of the area of immediate concern. The intervals chosen for the recoveries from the Caryn and Albatross III releases were October 22 through November 1, and November 1 through November 6 respectively, the dates of first releases and the dates by which 75 percent of the bottles had been recovered.

A summary of these data plus information on the speed of transport during these periods is presented in Table 2.

In general, the data on the direction of wind flow during the periods that drift bottles were recovered from the Balanus and Albatross III releases indicate that these bottles drifted against the prevailing winds for the intervals covered. Conversely, the bottles recovered from the Caryn releases drifted with the prevailing winds. What, then, was the effect of the prevailing winds on the speed of transport?

Drift bottles recovered from the Balanus and Albatross III releases attained a maximum speed of 8.5 miles-per-day and 9.5 miles-per-day respectively, drifting against the prevailing winds; those recovered from the Caryn releases attained a maximum speed of but 6.5 miles-per-day drifting with the prevailing winds. Drift bottles recovered from those that had been released in the disposal area attained a maximum speed of 9.5 miles-per-day against the prevailing winds while those drifting with the prevailing winds attained a maximum speed of but 2.3 miles-per-day. Could the presence or absence of drags have had any relation to this effect?

Of the 60 drift bottles recovered during the period 31 were originally released with drags. An analysis of the data indicates that bottles released with drags attained a greater speed of transport. These average 2.5 miles-per-day drifting with the prevailing winds while those without drags averaged but 1.7 miles-per-day. Bottles drifting against the prevailing winds averaged 5.5 miles-per-day with drags and 3.8 miles-per-day without drags.

These anomalies make it apparent that the direction of drift and speed of transport of floating objects in the ocean off the New Jersey coast was principally dependent upon the direction and rate of flow of the prevailing currents; and that prevailing winds had little effect upon the direction of drift.

Further studies on the effect of wind on surface currents and drift will be conducted in 1949.

SUMMARY AND CONCLUSIONS

This report is based upon the recorded findings of 60 drift bottles, the returns from 489 releases. Drift bottle releases were made in an area of the ocean off New Jersey and New York bounded on the east by longitude 73° 00' W., and on the south by latitude 40° 15' N., during July, October, and November 1948. The release stations numbered 32, inclusive of duplication. Half of the bottles were simply stoppered and half were stoppered and provided with 4-foot drags. These drags had the effect of

Table 2--The relation of winds and the behavior of drift bottles recovered on the New Jersey Coast in 1948

Releases and Recoveries	Direction From	Percent of Flow	Average Force (Knots)	SPEED OF TRANSPORT (M/DAY) From all Stations Maximum	From all Stations Average	From Disposal Area Maximum	From Disposal Area Average
BALANUS	NE	22.4	9.0	8.5	3.6	No N. J. returns	
July 27 -	NW	18.4	9.7				
Aug. 31	SE	15.0	6.7				
	SW	38.2	9.1				
	Var.	5.9	3.8				
CARYN	NE	68.3	14.4	6.5	2.2	2.3	1.7
Oct. 22 -	NW	26.1	15.4				
Nov. 1	SE	----	----				
	SW	2.7	8.0				
	Var.	2.9	4.2				
ALBATROSS III	NE	27.4	14.5	9.5	6.3	9.5	6.3
Nov. 1 -	NW	.7	2.0				
Nov. 6	SE	14.2	15.0				
	SW	55.5	14.7				
	Var.	2.2	3.5				

a sea anchor, minimizing the effect of wind-produced currents. The drift intervals varied from 1 day to 166 days. The recovery points were scattered between northern New Jersey and North Carolina. Thirty-one bottles among the returns were ones that had been released with drags.

A recapitulation of the releases and recoveries follows:

From 106 releases at 7 stations on a line approximately 3 miles off the New Jersey coast, 20 recoveries came from New Jersey and 3 came from southern points.

From 118 releases at 8 stations on a line approximately 10 miles off the New Jersey coast, 23 recoveries came from New Jersey and 4 came from southern points.

From 124 releases at 8 stations on a line approximately 17 miles off the New Jersey coast, 1 recovery came from New Jersey and 1 came from a southern point.

From 90 releases at 6 stations on a line approximately 25 miles off the New Jersey coast, 2 recoveries came from New Jersey and 6 came from southern points.

From 51 releases at 2 stations on a line approximately 40 miles off the New Jersey coast there were no recoveries.

A detailed study of these releases and recoveries indicated that:

1. Buoyant substances dumped into the waste disposal area off the New Jersey and New York coasts drift away.

2. The resultant drift prevailing from July through November of 1948 was south to southwest at probably a speed of 2 to 9 miles-per-day.

3. The direction and speed of transport was primarily dependent upon the prevailing currents rather than on winds.

4. There was a critical north-south line between 10 and 17 miles off the New Jersey coast. Bottles released west of this line reached New Jersey within a few days. Bottles released east of this line reached New Jersey only after two weeks if at all.

LITERATURE CITED

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